Planar fusion: A PICTORIAL REVIEW.

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Citation

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Abstract

Image fusion of SPECT and PET data with CT and MRI has been shown to improve diagnostic accuracy in a variety of clinical circumstances. While the use of SPECT/CT and PET/CT image fusion has been well documented in the literature, there has been limited documentation of the role of planar image fusion. This brief pictorial review provides case examples where planar fusion between bone scintigraphy and xray has been useful.

INTRODUCTION

Nuclear scintigraphy using single photon emission computed tomography (SPECT) provides functional information that is a valuable tool in the diagnosis of many diseases but is limited, on occasion, by less than ideal anatomic localization (1). Image fusion is a process of data superimposition using multiple image types; typically computed tomography (CT) or magnetic resonance imaging (MRI) for anatomic data superimposed with SPECT or positron emission tomography (PET) for functional data (1). Image fusion of SPECT and PET data to CT in particular has been shown to improve diagnostic accuracy in many clinical circumstances (2).

While the use of SPECT/CT (3-5) and PET/CT (6-8) image fusion has been well documented in the literature, there has been limited documentation of the role of planar image fusion. Zuckier and Koncicki (9) reported using planar image fusion between planar scintigraphic and photographic images to better localize the position of focal radiopharmaceutical accumulation in low background images. More recently, fusion of planar scintigraphy to photographs was reported to offer more as a promotional tool than as a tool to improve diagnostic certainty (10). None the less, fusion of scintigraphy to photographs might benefit research studies that involve imaging of non human subjects where anatomy may be foreign to nuclear medicine experts (e.g. plant and animal studies). Zuckier and Koncicki (9) also reported using planar image fusion between orthopedic xrays and photographic images. Fusion of scintigraphy with photographs is limited by the ‘pin hole’ effect causing misalignment (10).

CASE EXAMPLES

A more useful application of planar fusion would be fusing orthopedic xrays with bone scintigraphy. Despite the apparent transparency of benefits, planar fusion between xray and bone scan has only once been reported in the literature (10). Combining the high spatial resolution of xrays with the physiologically sensitive bone scan assist in overcoming the limitations of each. This brief pictorial review presents case examples (figures 1 to 8) where planar fusion between bone scintigraphy and xray has been useful.

Figure 1

Figure 1: A 72 year old female with a history of osteoarthritis in both hands and a past history of melanoma. A three phase bone scan was performed of the wrists and hands. Delayed bone scan showed bilateral increased tracer activity at the bases of the thumbs. Fusion images of the right hand showed increased activity in the carpometacarpal joint of the thumb, both the trapezium and trapezoid and the adjacent junction with the scaphoid. The activity on the left hand was more focal.

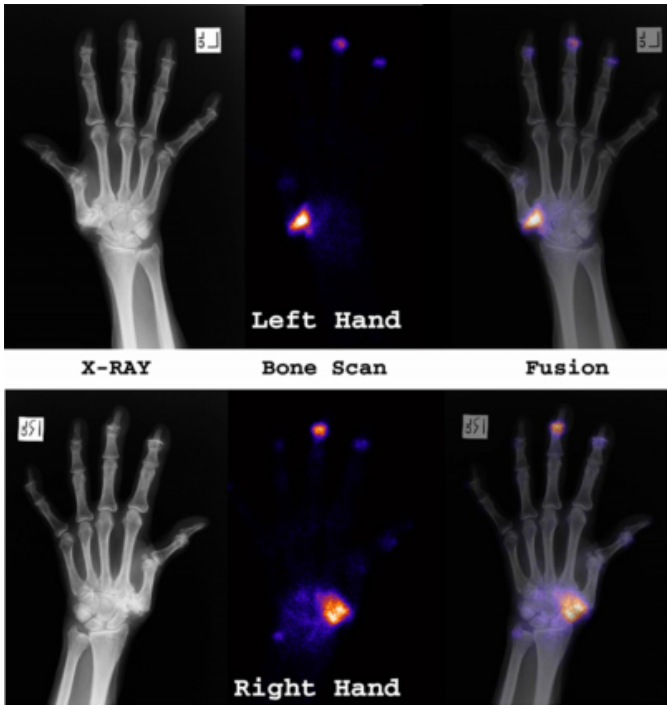


Figure 2

Figure 2: A 55 year old policeman. With recent (one week) onset of right forefoot pain. The bone scan demonstrated increased vascularity with moderate periarticular activity in the right first and second MTP joints and at the right second/third tarsometatarsal joints and proximal metatarsal articulations. There was normal activity within the metatarsal shafts as demonstrated on fusion images indicating inflammatory arthropathy/synovitis rather than stress fracture.

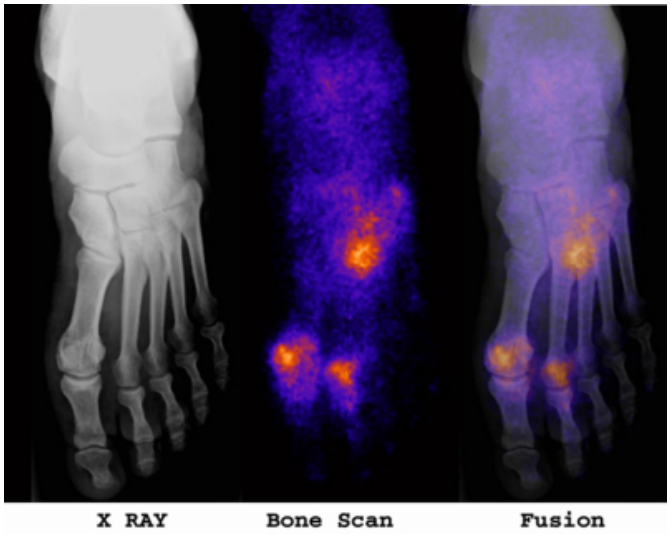


Figure 3

Figure 3: A 57 year old male presenting with painful inflammation and swelling over the posterior right heel at the Achilles' tendon insertion. Three phase bone scan showed localised prominent hypervascularity over the posterior aspect of the right calcaneus with corresponding discrete accentuation of osteoblastic activity is on delayed images corresponding to the Achilles' tendon insertion due to focal inflammatory enthesitis.

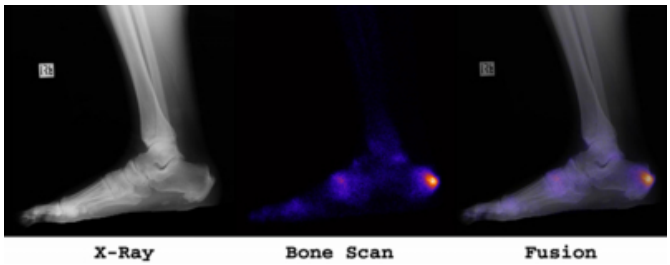


Figure 4

Figure 4: A 57 year old female with ongoing right hip, groin and buttock pain following a fall several months earlier. A three phase bone scan was performed although early phases were unremarkable. Delayed images showed a mild focal uptake in the right greater trochanter in keeping with avulsion injury/enthesopathy at the insertion of the gluteus muscles. Mild increased uptake is noted at the superior aspect of both hip joints corresponded to marginal osteophytes seen on x-ray.

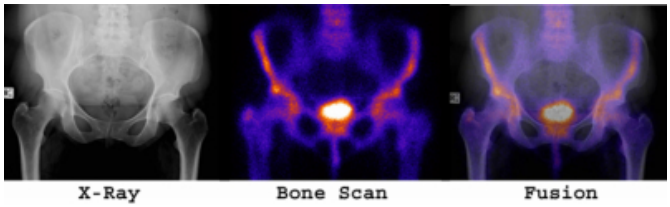


Figure 5

Figure 5: A 59 year old female with 12 months of right calcaneal discomfort. A three phase bone scan was performed with both blood pool and delayed images showing a focus of increased tracer activity that localises to the medial part of the anterior portion of the subtalar joint. This abnormality is unlikely to represent residual activity associated with a fracture as it does not spread significantly into either adjacent talus or calcaneum

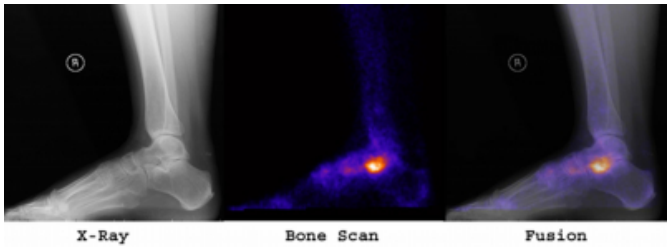


Figure 6

Figure 6: A 57 year old female with a history of left heel pain. The three phase bone scan showed increased vascularity at posterior left plantar fascia corresponding to delayed images showing activity at left calcaneal plantar fascia insertion (plantar fasciitis). Uptake was also noted in the left subtalar joint (anterior facet), the left calcaneal cuboid joint superiorly and left talonavicular joint on the dorsal aspect.

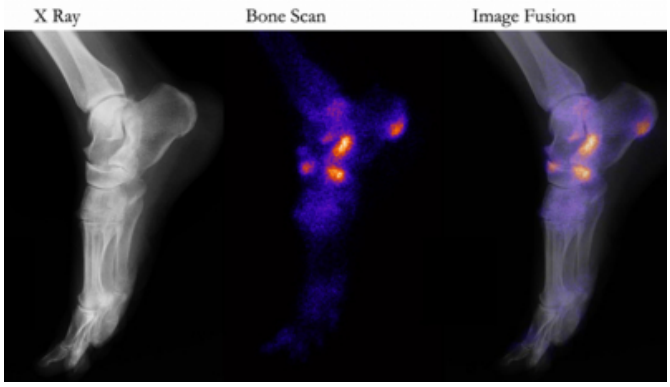


Figure 7

Figure 7: A 46 year old female with a history of a left ankle injury 10 days earlier. Despite a lack of improvement in clinical symptoms, the xray was normal. The three phase bone scan showed intensely increased vascularity and delayed uptake at the distal left cuboid joint/fifth tarsometatarsal joint. Mild uptake was also noted at the left superior cuboid joint in the region of the tri-articulation of the cuboid/talus/navicular. While no fracture was noted, the abnormality at the left first metatarsal base/left fifth tarsometatarsal joint are suggestive of traumatic enthesopathy related to peroneal tendon insertion and/or post-traumatic synovitis within the joint.

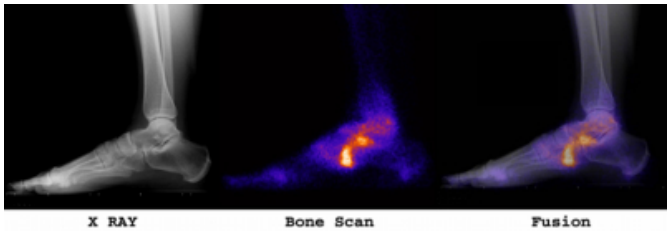
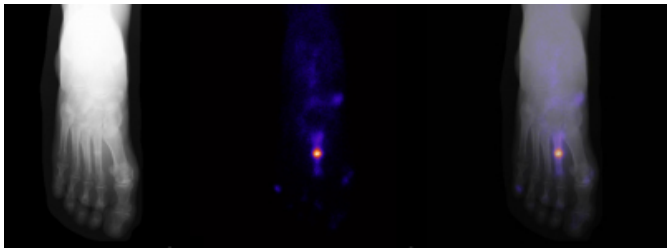


Figure 8

Figure 8: A 77 year old woman with left foot pain after a stumble five weeks earlier. The three phase bone scan showed localised central left forefoot hyperaemia corresponding to localised delayed accumulation in the second metatarsal shaft consistent with a stress fracture. There is also diffuse activity extending proximally and distally along the metatarsal.



CONCLUSION

Planar image fusion of bone scintigraphy and xray may provide a useful tool to improve diagnostic utility and / or interpretive certainty. The utility of xray fusion allows more precise anatomical reference to bone involvement. It is not uncommon for the combined image fusion data to provide additional clinical information that was not evident from either anatomic or functional datasets; interpreted in isolation or in tandem without fusion.

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